Effect of Method of Catching on the Sensory Quality of Inshore-Newfoundland Caught Cod *(Gadus morhua)*

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by

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ABSTRACT

Botta, J.R. and B.E. Squires. 1983. Effect of method of catching on the sensory quality of inshore-Newfoundland caught cod (Gadus morhua). Can. Tech. Rep. Fish. Aquat. Sci. 1164: iv + 18 p.

A laboratory-type study was conducted to assess the sensory quality of both raw cod (dockside grade) and cooked cod fillets from cod which had been caught by baited hook, gillnets set for various periods of time, and trap. All samples were handled according to Department of Fisheries and Oceans recommended groundfish handling procedures. The quality and consistency of cod caught by baited hook was impressive. The sensory quality of cod caught by trap did not substantially differ from that of cod caught by baited hook. The quality of cod which had been caught by gillnets set 1 and 2 d was very slightly and very moderately inferior, respectively, to cod caught by baited hook. However, when the gillnets had been set 3, 4 or 5 d, the overall sensory quality of both raw and cooked cod was greatly inferior to that of cod caught by baited hook. Whenever the gillnets were set 6 d, the high reject level made the entire lot unacceptable.

Key Words: Atlantic cod, baited hook, catching, Gadus morhua, gillnet, quality trap.

Résumé

Botta, J.R. and B.E. Squires. 1983. Effect of method of catching on the sensory quality of inshore-Newfoundland caught cod (Gadus morhua). Can. Tech. Rep. Fish. Aquat. Sci. 1164: iv + 18 p.

Une etude de laboratoire a été faite pour établir la qualité sensorielle de la morue crue et la morue en filets cuisineé qui avait été pecheé avec des hamecons amorceés, et enfin la morue attrapeé par filets et par cages. Tous les échantillons ont étè manipulés selon les procedés recommandés pour le Department des Pêches et Oceans. La qualité et la consistance de la morue amorceé etaient impressionantes. La qualité sensorielle de la morue attrapeé par cage n'etaient pas substantiellement different de la premiere. Mais la qualité sensorielle de la morue pêcheé par filets series 1 et 2 était differente et moderement inferieure à celle pêchée pour hamecons. Toutefois, lorsque les filets étaient en series 3, 4 on 5 d, la qualité sonsorielle de la morue crue et celle cuisineé etait bien inferieure a celle de la morue pêcheé par hamecons. Chaque fois que les filets etaient usés en serie 6 d le mireau de rejet etait si haut que tout le lot en entier etait inacceptable.

INTRODUCTION

It is generally recognized that inshore-Newfoundland caught fish may often be of poor quality (Anon. 1980; Blackwood 1976; Newbury 1976; Pottle 1976; Wicks 1976) and the method by which the fish are caught has been regarded as one of the important contributing factors (Anon. 1980; Pottle 1976; Wicks 1976). Although a grade "B" price for cod does exist (Anon. 1981), the receipted prices on purchase slips collected by the Department of Fisheries and Oceans indicate that in recent years very little cod has been purchased as grade B, except in pilot project areas (D. Tilley, Department of Fisheries and Oceans, Statistics and Systems Branch, St. John's, NF; pers. comm.). Thus, in practice, with cod of similar size, the method of catching is the only major factor that determines the price which fishermen receive (Anon. 1981).

Numerous public statements regarding the method of catching fish and the good or poor quality of the catch have recently been made. These statements were usually opinions, however, and were not based on objective investigations.

The present investigation was initiated to determine whether three methods of catching (baited hook, gillnet and trap) resulted in cod with different sensory qualities.

MATERIALS AND METHODS

RAW MATERIALS

During the period between June 15 and July 31, 1982, cod were caught by gillnets which had been set for 1, 2, 3, 4, 5 or 6 d and the sensory quality of random samples were compared to that of cod caught by baited hook. The cod were caught on Cape Ballard Bank (approximately 46°44'N; 52°50'W) at depths of approximately 37 m. Each day that gillnets were hauled, cod were caught in the same vicinity by baited hook, to be used as controls. Between July 21 and 24, 1982, cod were caught by a trap set near Renews, NF. The sensory quality of such samples were compared to cod caught on the same day by baited hook on Cape Ballard Bank. Thus, there were seven different treatments plus the control.

As soon as the cod were brought onboard, they were categorized as alive or dead and each category kept separate but treated in an identical manner. After having the artery cut just anterior to the heart, all fish were allowed to lie for 15 min, gutted, washed and iced (3 parts fish to 1 part ice) in plastic boxes (68 cm x 43 cm x 27 cm) fitted with drain holes positioned so that, when the boxes were stacked, water did not drain from one box to the one below. The boxes were placed inside containers insulated with 6.3 cm polyurethane and equipped with a tight-fitting lid. Except for the gillnets set 6 d, which could only be replicated two times, each treatment was replicated at least

four times with at least eight fish sampled per replication. Care was taken to ensure that the ratio of alive to dead fish in the sample was similar to that observed when the fish first came onboard.

ASSESSMENT OF RAW COD

During the course of the study, the temperature of some of the fish was determined both when they first came onboard and when they arrived at dockside. Within 2 h of reaching port or 15 h of catching, the samples of raw gutted cod were graded by a trained employee of the Department of Fisheries and Oceans, Inspection Division, using the Department of Fisheries and Oceans proposed dockside grading standards (Table 1).

After each raw fish was graded, filleting was completed and both fillets were rinsed, allowed to drain, packed individually into 0.5 kg capacity waxed cardboard boxes and frozen at -20°C. Within 1 wk the samples were transported to St. John's where they were wrapped with an oxygen impermeable film and stored at -40°C until analyzed.

ASSESSMENT OF COOKED COD

The contents of each 0.5 kg capacity box used for sensory evaluation were trimmed, sawn into equal sized (1.2 cm x 2.5 cm x 7.5 cm) pieces, placed into an aluminum pan, covered with aluminum foil, baked at 204°C for 40 min in a conventional oven, transferred to coded glass petri dishes and served hot using an electric warming tray. Evaluations were made in partitioned booths with daylight fluorescent light using room temperature tap water for rinsing between samples.

On at least ten different occasions samples from each treatment, except that of gillnets set 6 d when there were only six different occasions, were presented to sensory evaluation panels consisting of 18 judges. At any one session, each judge was presented with three samples (two from one of the seven treatments and one sample caught by baited hook or one sample from one of the treatments and two samples caught by baited hook) caught at the same time and, with the exception of trap-caught cod, caught in the same area. The judges were then asked to choose which sample was different from the other two (Table 2). The samples were evaluated within 15 min and all sessions were completed by November 1, 1982.

ASSESSMENT OF DATA

Observed frequency distributions (the percentage of times each treatment combination received each of the grades) were calculated for all dockside grades assigned to raw fish.

Mean fish temperature and length values, including standard deviations, were calculated.

Table 1. Dockside grading standards (cod) that were in existence June 15, 1982.

Grades will be assigned using the combination of factors under Texture and Handling Practices (Table A), Examination in the Round, Gutted or Headed Form (Table B), and Examination of Cut Surfaces (Table C).

Table 1A Texture and Handling Practices

Grade "A"

The fish is firm and resilient and has been bled, gutted, washed and iced at sea.

Grade "B"

The fish is firm and resilient and has not been bled, gutted, washed and iced at sea;

OR

The fish is slight to moderately soft and has been bled, gutted, washed and iced at sea.

Grade "C"

The fish is slight to moderately soft and has not been bled, gutted, washed and iced at sea;

OR

The fish is soft and has been bled, gutted, washed and iced at sea.

Reject The fish is:

i) tainted, decomposed or unwholesome, OR
ii) soft and has NOT been bled, gutted, washed and iced at sea, OR
iii) generally soft and flabby, OR
iv) reject by criteria in Table B or C.

Table 1B Examination in Round, Gutted or Headed Form

Fish will be graded into Grades "A" or "B/C" by rating all characteristics which are available and averaging the number of defect points for these characteristics (eg. in headed fish, eyes and gill odor and color cannot be examined).

Fish will be rejected if (a) the odor at the neck when broken is faint or medium or strong sour or putrid, or (b) the odor of the gills is moderate to strong sour.

Grade "A": Average defect points less than 2.

Grade "B/C": Average defect points 2 or more.

Characteristic	Defect	Points
Odor at neck when broken	Neutral	2
Odor - Gills	Neutral	1
	Faint sour	2
	Slight to moderate sour	3
General appearance	Very little, if any, bleaching	1
	Some loss of metallic lustre, some bleaching	2
	Bloom gone and color faded or bleached	3
Eyes	May be slightly sunken or somewhat dull	1
	Dull, slightly sunken and/or slightly cloudy	2
	Dull, sunken and cloudy	3
Color of Gills	Slightly pinkish red	1
	Pinkish-red to brownish red, some mucus may be present	2
	Brown or grey and may be covered with mucus	3

Table 1C Examination of Cut Surfaces

Fish will be graded into Grades "A", "B", "C", or "Reject" on the basis of the severity of the following defects.

Defect	Severity	Grade
Blood clots (greater than 1/2 cm in any dimension)	None	A
	No combination of blood clots exceeding 4 cm in total maximum dimension in any one fillet	B
	One or any combination of blood clots which exceeds 4 cm in total maximum dimension in any one fillet	C
Discolorations (including bruising)	No single discoloration, nor any combination, exceeding 2 cm in total maximum dimension in any one fillet	A
	No single discoloration, nor any combination, exceeding 5 cm in total maximum dimension in any one fillet	B
	Any single discoloration or combination the total surface area of which does not exceed 50% of the total surface area of any one fillet	C
	Any discoloration, the total surface area of which exceeds 50% of the total surface area of any one fillet	Reject

Table 2. Form used to evaluate sensory quality of cooked cod fillets.

NAME _____ DATE _____

PRODUCT _____

Two of these three samples are identical, the third is different.

1. Evaluate the samples in order indicated and identify the different sample.

Code	Check different sample
_____	_____
_____	_____
_____	_____

2. Indicate the degree of difference between the duplicate sample and the different sample

   Slight _____

   Moderate _____

   Much _____

   Extreme _____

3. Is the different sample acceptable? _____
   Are the duplicate samples acceptable? _____

4. Is the different sample more acceptable? _____
   Are the duplicate samples more acceptable? _____

5. Is the difference related to: Appearance _____
   Flavor _____
   Odor _____
   Texture _____

6. Comments:

Since the triangle test is based on the assumption that if there is no detectable difference, the "different" sample will be selected by chance one-third of the time, the results of the present sensory evaluation of cooked fish were analyzed by comparison with tabulated values (Roessler et al. 1948, 1956). Unless otherwise stated, "significant" means significant at the 5% level (i.e. the probability of the difference occurring by chance alone is 5%).

RESULTS AND DISCUSSION

QUALITY OF RAW COD

In general, the dockside quality of cod caught by gillnets was substantially inferior to that caught by baited hook. This was not true, however, when the gillnets were set for 1 d (Table 3). Such fish were of very good quality and only slightly inferior, there being an average of 85% grade A fish in the catches compared with 96.9% grade A with fish caught by baited hook (Table 3). Although cod caught by gillnets set 2 d were definitely inferior to those caught by baited hook, the quality was still good (79.5% grade A, 15.9% grade B and 4.5% grade C). The overall quality of cod caught by gillnets set 3 or 4 d was relatively poor: 50-58% grade A, 17-31% grade B, 17-22% grade C and 3% reject. Cod caught by gillnets set 5 or 6 d was of even lower quality with the catch consisting of 40-42% grade A, 21-25% grade B, 15-30% grade C and 6-20% reject fish (Table 3).

Regardless of the length of time the gillnets were set, fish which were alive when they first came onboard were at least 81.8% grade A, no more than 18.2% grade B and no more than 12.5% grade C (Table 3). In contrast, fish which were dead when they first came onboard were very greatly affected by the length of time the nets were set. Although nets set 2 d contained 52% dead fish, 77.8% of these dead cod were rated grade A; nets set 4 d contained 47.2% dead fish of which only 17.6% were rated grade A (Table 3).

In general, the amount of reject fish became noticeable (3%) when the nets were set 3 or 4 d, readily apparent (6%) when the nets were set 5 d, and constituted a substantial part of the catch (20%) when the nets were set 6 d (Table 3). This was directly related to the amount of cod that were dead when first brought onboard as no fish that was alive when it came onboard was ever rated reject (Table 3). The amount of cod dead when brought onboard increased from 20% with gillnets set 1 d to approximately 50% when the nets were set 2, 3 or 4 d to 68% when set 5 d and 85% when set 6 d (Table 4).

Cod caught by trap were rated as 92.9% grade A, 5.7% grade B and 1.4% grade C (Table 3). This compared very well with cod caught by baited hook, rated 98.0% grade A and 2.0% grade B (Table 3).

Both the overall consistency and the overall high quality of cod caught by baited hook was very impressive (Tables 3 and 7).

Table 3. Percentages of assigned dockside grades of raw gutted cod caught by different procedures.

Treatment							Control (baited hook)				
			Grade (%)					Grade (%)			
		n	A	B	C	R	n	A	B	C	R
Gillnet											
set 1 d	live cod	32	87.5	6.3	6.3	-	32	96.9	3.1	-	-
	dead cod	8	75.0	25.0	-	-					
	Total	40	85.0	10.0	5.0	-					
set 2 d	live cod	17	82.4	5.9	11.8	-	43	97.6	2.3	-	-
	dead cod	27	77.8	22.2	-	-					
	Total	44	79.5	15.9	4.5	-					
set 3 d	live cod	16	81.3	6.3	12.5	-	37	97.3	2.7	-	-
	dead cod	20	25.0	50.0	20.0	5.0					
	Total	36	50.0	30.6	16.7	2.7					
set 4 d	live cod	19	94.7	5.3	-	-	40	97.5	2.5	-	-
	dead cod	17	17.6	29.4	47.1	5.9					
	Total	36	58.3	16.7	22.2	2.8					
set 5 d	live cod	11	81.8	18.2	-	-	40	97.5	2.5	-	-
	dead cod	22	22.7	22.7	45.5	9.1					
	Total	33	42.4	21.2	30.3	6.1					
set 6 d	live cod	3	100.0	-	-	-	20	95.0	5.0	-	-
	dead cod	17	29.4	29.4	17.6	23.5					
	Total	20	40.0	25.0	15.0	20.0					
Trap	live cod	70	92.9	5.7	1.4		50	98.0	2.0	-	-

n = number of samples evaluated for each treatment method.

Table 4. Percentages of the state of the fish when first brought onboard

Treatment	Live cod (%)	Dead cod (%)
Gillnet		
set 1 d	80.0	20.0
set 2 d	47.7	52.3
set 3 d	44.4	56.6
set 4 d	52.8	47.2
set 5 d	33.3	67.7
set 6 d	15.0	85.0
Trap	100.0	0.0
Control (baited hook)	100.0	0.0

QUALITY OF COOKED COD

The quality of cooked cod which had been caught by gillnets set 1 d did not significantly differ from that caught by baited hook (Table 5). With cod caught by gillnets set 2 d there was a highly significant ($P \leq 0.01$) difference from control samples but neither the gillnet samples nor the baited hook samples were preferred (Table 5). However, there was both a significant difference between the treatments and the control as well as a significant preference for the baited hook samples when gillnets were set 3, 4, 5 or 6 d (Table 5). These significant differences and preferences were almost entirely related to the percentage of cod being dead when brought onboard (Table 5). In only one instance, gillnets set 2 d, was there a significant difference with live cod, but as there was no significant preference (Table 5), the difference is somewhat meaningless.

The acceptability of the gillnet-caught cod decreased from 79.2% for gillnets set 1 d to 29.5% when gillnets were set 6 d (Table 6). The acceptability of cod taken from nets set 2, 3, 4 or 5 d was approximately 60%. The changes in acceptability were largely due to the condition of the fish (alive or dead) when brought onboard (Table 6). Although there was considerable variability, the acceptability of the cod caught by baited hook was usually in the 80-90% range (Table 6).

The sensory evaluation panel observed a significant difference between samples caught by trap and those caught by baited hook, but there was no definite preference for fish caught by either of the two procedures (Table 5). In fact, the 85.7% acceptability of cod caught by trap compared very well with the 78.2% acceptability of cod caught by baited hook (Table 6).

GENERAL DISCUSSION

The down-grading of the quality of the raw cod caught by baited hook or by trap appeared to be largely due to discoloration (bruises) (Table 7). With gillnet-caught cod, the down-grading was caused by discoloration and, particularly when the nets were set for a long time, by poor texture (Tables 7-9). With cooked cod the majority of differences were rated as moderate. Flavor and appearance were often the most important reason for the differences but texture and, to a lesser degree, odor were also important factors.

The present results for fish caught by baited hook, trap or by gillnets set for 1 d compare very well with the grades assigned cod caught commercially and handled in a similar manner during the 1981 Bonavista Peninsula Pilot Project (White 1982). The present results also compare well with those observed by Botta et al. (1982) when considering trap-caught cod gutted and iced at sea. Although with gillnets set 2-6 d the percentage of samples rated grade A was higher than that observed by White (1982) during the Bonavista Peninsula Pilot Project, the overall trend was somewhat similar.

Table 5. Results of sensory evaluation triangle test using fillets of cod caught by gillnet or trap versus that caught by baited hook.

Treatment		n	Number of correct identifications	Preference: Samples from cod caught by gillnet or trap	Preference: Samples from cod caught by baited hook	Preference: None
Gillnet						
set 1 d	live cod	180	57$^{n.s.}$	27	26	4
	dead cod[1]	45	14$^{n.s.}$	5	7	2
	Total	225	71$^{n.s.}$	32	33	6
set 2 d	live cod	72	34*	12	18$^{n.s.}$	4
	dead cod[1]	108	52*	16$^{n.s.}$	29$^{n.s.}$	7
	Total	180	86**	28	37$^{n.s.}$	11
set 3 d	live cod	81	28$^{n.s.}$	14	10	4
	dead cod[1]	117	55*	6	42**	7
	Total	198	83***	20	52**	11
set 4 d	live cod	99	24$^{n.s.}$	10	9	5
	dead cod[1]	107	61***	10	48***	3
	Total	206	85*	20	57**	8
set 5 d	live cod	63	22$^{n.s.}$	8	11	3
	dead cod[1]	117	61***	8	41**	12
	Total	180	81**	16	52**	15
set 6 d	live cod	9	1$^{n.s.}$	1	0	0
	dead cod[1]	99	60***	6	49***	5
	Total	108	61***	7	49***	5
Trap	live cod	313	148**	50	82$^{n.s.}$	16
	dead cod	-	-	-	-	-
	Total	313	148**	50	82$^{n.s.}$	16

n = number of observations for each treatment method

n.s. Not significant at the 5% level
* Significant at the 5% level
** Significant at the 1% level
*** Significant at the 0.1% level

[1] Only samples caught by gillnet were dead when brought onboard. They were compared, using a triangle test, to cod caught by baited hook which were alive when brought onboard.

Table 6. Acceptability of correctly-identified sets of cooked cod fillets.

Treatment		n	Percentage of correctly-identified sets: Samples from cod caught by gillnet or trap	Samples from cod caught by baited hook (control) live fish
Gillnet				
set 1 d	live cod	180	79.3	77.6
	dead cod[1]	45	78.6	71.4
	Total	225	79.2	76.4
set 2 d	live cod	72	61.8	79.4
	dead cod[1]	108	63.5	80.8
	Total	180	64.3	82.1
set 3 d	live cod	81	78.6	82.1
	dead cod[1]	117	47.3	89.1
	Total	198	58.5	87.8
set 4 d	live cod	99	70.8	79.2
	dead cod[1]	108	55.7	88.5
	Total	207	60.0	85.9
set 5 d	live cod	63	90.9	86.4
	dead cod[1]	117	50.8	88.5
	Total	180	61.4	88.0
set 6 d	live cod	9	100.0	100.0
	dead cod[1]	99	28.3	88.3
	Total	108	29.5	88.5
Trap	live cod	314	85.7	78.2
	dead cod	-	-	-
	Total	314	85.7	78.2

n = number of observations per treatment method

[1] Only samples caught by gillnet were dead when brought onboard. They were compared, using a triangle test, to cod caught by baited hook which were alive when brought onboard.

Table 7. Factors contributing to down-grading of inshore-caught cod.

Treatment	n	Grade	Factors				
			Texture	Intrinsic	Blood clots	Discoloration	Final grade
Gillnet							
set 1 d	40	A	95.0	100.0	100.0	87.5	85.0
		B	5.0	-	-	10.0	10.0
		C	-	-	-	2.5	5.0
		R	-	-	-	-	-
set 2 d	44	A	88.6	100.0	100.0	88.6	79.5
		B	11.4	-	-	6.8	15.9
		C	-	-	-	4.5	4.5
		R	-	-	-	-	-
set 3 d	36	A	66.7	97.2	100.0	50.0	50.0
		B	33.3	2.8	-	30.6	30.6
		C	-	-	-	16.7	16.7
		R	-	-	-	2.8	2.8
set 4 d	36	A	61.1	97.2	100.0	66.7	58.3
		B	30.6	-	-	11.1	16.7
		C	8.3	-	-	22.2	22.2
		R	-	2.8	-	-	2.8
set 5 d	33	A	51.5	93.9	100.0	42.4	42.4
		B	30.3	6.1	-	21.2	21.2
		C	15.2	-	-	30.3	30.3
		R	3.0	-	-	6.1	6.1
set 6 d	20	A	50.0	80.0	95.0	80.0	40.0
		B	45.0	20.0	5.0	20.0	25.0
		C	5.0	-	-	-	15.0
		R	-	-	-	-	20.0
Baited hook	115	A	99.1	100.0	99.1	98.3	96.5
		B	0.9	-	0.9	1.7	3.5
		C	-	-	-	-	-
		R	-	-	-	-	-
Trap	70	A	100.0	100.0	97.1	95.7	92.9
		B	-	-	2.9	2.9	5.7
		C	-	-	-	1.4	1.4
		R	-	-	-	-	

n = number of samples evaluated for each treatment

Table 8. Factors contributing to down-grading of inshore-caught cod which were alive when brought onboard ship.

Treatment	n	Grade	Factors				
			Texture	Intrinsic	Blood clots	Discoloration	Final grade
Gillnet							
set 1 d	32	A	96.9	100.0	100.0	90.6	87.5
		B	3.1	-	-	3.1	6.2
		C	-	-	-	6.3	6.2
		R	-	-	-	-	-
set 2 d	17	A	94.1	100.0	100.0	82.4	82.4
		B	5.9	-	-	5.9	5.9
		C	-	-	-	11.8	11.8
		R	-	-	-	-	-
set 3 d	16	A	100.0	100.0	100.0	81.2	81.2
		B	-	-	-	6.2	6.2
		C	-	-	-	12.5	12.5
		R	-	-	-	-	-
set 4 d	19	A	100.0	100.0	100.0	94.7	94.7
		B	-	-	-	5.3	5.3
		C	-	-	-	-	-
		R	-	-	-	-	-
set 5 d	11	A	100.0	100.0	100.0	81.8	81.8
		B	-	-	-	18.2	18.2
		C	-	-	-	-	-
		R	-	-	-	-	-
set 6 d	3	A	100.0	100.0	100.0	100.0	100.0
		B	-	-	-	-	-
		C	-	-	-	-	-
		R	-	-	-	-	-
Baited hook	115	A	99.1	100.0	99.1	98.3	96.5
		B	0.9	-	0.9	1.7	3.5
		C	-	-	-	-	-
		R	-	-	-	-	-
Trap	70	A	100.0	100.0	97.1	95.7	92.9
		B	-	-	2.9	2.9	5.7
		C	-	-	-	1.4	1.4
		R	-	-	-	-	-

n = number of samples evaluated for each treatment method

Table 9. Factors contributing to down-grading of inshore-caught cod which were dead when brought onboard ship.

			Factors				
Treatment	n	Grade	Texture	Intrinsic	Blood clots	Discoloration	Final grade
Gillnet							
set 1 d	8	A	87.5	100.0	100.0	75.0	75.0
		B	12.5	-	-	25.0	25.0
		C	-	-	-	-	-
		R	-	-	-	-	-
set 2 d	27	A	85.2	100.0	100.0	92.6	77.8
		B	14.8	-	-	7.4	22.2
		C	-	-	-	-	-
		R	-	-	-	-	-
set 3 d	20	A	40.0	95.0	100.0	25.0	25.0
		B	60.0	5.0	-	50.0	50.0
		C	-	-	-	20.0	20.0
		R	-	-	-	5.0	5.0
set 4 d	17	A	35.3	94.1	100.0	47.1	17.6
		B	47.1		-	11.8	29.4
		C	17.6	-	-	41.2	47.1
		R	-	5.9	-	-	5.9
set 5 d	22	A	27.3	90.9	100.0	22.7	22.7
		B	45.4	9.1	-	22.7	22.7
		C	22.7	-	-	45.4	45.4
		R	4.5	-	-	9.1	9.1
set 6 d	17	A	41.2	76.5	94.1	76.5	29.4
		B	52.9	23.5	5.9	23.5	29.4
		C	5.9	-	-	-	17.6
		R	-	-	-	-	23.5

n = number of samples evaluated for each treatment method

The size of the cod may have affected differences in sensory quality between gillnet and baited hook caught fish as well as between cod caught by trap and baited hook. This may have been particularly important when factors other than discoloration caused the down-grading of raw trap-caught cod or caused the cooked trap-caught cod to be inferior to cooked cod caught by baited hook. In general, cod caught by baited hook (65.5 cm long $\pm$ 8.1 cm) were slightly larger than those caught by trap (56.8 cm long $\pm$ 7.2 cm) and it has been stated that larger cod keep better than smaller cod (Connell 1980). However, with cod caught by gillnets, it appears that the method itself caused the lower quality (Tables 3, 5-9) as these cod, although slightly larger (74.4 cm long $\pm$ 9.5 cm), were often inferior to cod caught by baited hook.

The relatively high temperatures of trap-caught cod as they were brought onboard (Table 10) indicates the importance of gutting, washing and icing the fish as soon as they are brought onboard (Castell 1953). Upon arrival at dockside, the temperature of cod caught by trap was substantially greater than that of cod caught by baited hook or gillnet because the trap cod, caught very close to Renews, were not iced for as long a period of time. All fish were graded shortly after arrival at dockside.

Although the Department of Fisheries and Oceans Proposed Standards for Dockside Grading of Groundfish were used when assessing quality, the standards used were those which existed during June 1982, not those presently being tested.

Data regarding cod caught by gillnets set 6 d are included in this report, however, such data should be interpreted somewhat cautiously as the number of cod studied was relatively small. However, the results followed general trends observed with the other gillnet-caught cod.

Similarly, even though the results regarding preference and acceptability were reported and discussed in detail, it must be remembered that these data resulted from secondary questions and should be interpreted more cautiously than those resulting from the primary question, i.e. is there a difference?

It is recognized that location of catching may affect the sensory quality of the fish (Love 1975a, b) and that the baited hook samples were taken approximately 19 km from where the trap-cod were caught. However, the trap-caught samples were rated 92.9% grade A indicating that they were of very good quality. In addition, it is recognized that the time of season and the physiological condition of the cod may affect the sensory quality of the fish (Connell 1980; Idler et al. 1965; Love 1975b). It should be remembered that the present results were obtained in a laboratory-type study under well-defined conditions using relatively small amounts of fish. Under commercial conditions, with a wide variety of locations, seasons and catching and handling procedures, the results will not necessarily be the same. It should be noted as well that the sensory quality of the cooked fillets was evaluated by a laboratory panel and not by a consumer panel or through test marketing. A laboratory panel's assessment will not necessarily agree with that of the general public; consequently, this report should be viewed as an intermediate one.

Table 10. Temperature of fish when first taken onboard and upon arrival at dockside.

Date	n	Treatment	Temperature when first taken onboard	Temperature upon arrival at dockside
July 21/83	5	Gillnet - live cod	2.6 ± 0.4	0.6 ± 1.3
	5	- dead cod	2.0 ± 0.0	0.7 ± 1.2
	13	Trap - live cod	5.2 ± 0.6	4.7 ± 1.1
	5	Baited hook - live cod	2.8 ± 0.3	0.8 ± 1.3
July 22/83	5	Gillnet - live cod	2.0 ± 0.0	0.7 ± 0.8
	5	- dead cod	1.1 ± 0.2	0.3 ± 0.5
	15	Trap - live cod	5.9 ± 0.6	2.7 ± 1.0
	5	Baited hook - live cod	2.1 ± 0.2	1.1 ± 1.3

n = number of observations per treatment method

CONCLUSIONS AND RECOMMENDATIONS

A laboratory-type study was conducted to assess the effects of method of catching on sensory quality of raw and cooked cod.

Cod caught by baited hook and handled well (bled, gutted, washed and iced at sea) were of excellent sensory quality in both the raw (96.5% grade A) and cooked state.

Gillnetting definitely down-graded the quality of both raw and cooked samples:

i) cod (bled, gutted, washed and iced at sea) caught when the gillnets were set 1 d were only slightly to moderately down-graded (85% grade A);

ii) when the nets were set 2 d, the down-grading was moderate (79.5% grade A), but when set 3 or 4 d, the down-grading was very substantial (50-58% grade A) and when set 5 d, the down-grading was moderately greater (42% grade A and 6% reject);

iii) when set 6 d, the overall quality was rated reject (40% grade A and 20% reject);

iv) the down-grading caused by gillnetting was mainly due to: a) the fish being dead (blood clots, bruises and poor texture) when they were brought onboard, and b) bruising of live fish;

v) regardless of the length of time the gillnets were set, the quality of cod brought onboard alive was usually very good (at least 80% grade A), and when cooked, this cod which was alive when brought onboard was as acceptable to the judges as samples caught by baited hook.

The sensory quality of raw or cooked cod which had been caught by trap and handled in the Department of Fisheries and Oceans' recommended manner was not substantially different from that of cod caught by baited hook.

It is recommended that:

i) commercial inshore fishermen consider bleeding, gutting, washing and icing their cod at sea regardless of how the cod was caught;

ii) in order to obtain good quality fish, they consider hauling <u>all</u> their gillnets once a day or, if this is not possible, at least every other day;

iii) fishermen consider categorizing their cod as alive or dead when they come onboard and ensuring that the two categories are kept separate;

iv) quality, as determined by dockside grading, and not the method of catching per se (which is presently the case) be the factor that determines the price which fishermen receive.

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